Introgression of genetic material from primary synthetic hexaploids into an Australian bread wheat (*Triticum aestivum* L.)

A thesis submitted in fulfilment of the requirements for the degree of Master of Agricultural Science at the University of Adelaide

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March 2011

Abbreviations

CIMMYT : International Maize and Wheat Improvement Center
MPBCRC : Molecular Plant Breeding Cooperative Research Centre
AGT : Australian Grain Technologies
GRDC : Grains Research and Development Corporation
SARDI : South Australian Research and Development Institute
AWCC : Australian Winter Cereals Collection
BC : Backcross
BLUP : Best linear unbiased prediction
DArT : Diversity Array Technology™
SSR : Simple sequence repeats
AFLP : Amplified fragment length polymorphisms
QTL : Quantitative trait loci

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Abstract

Primary synthetic wheats, created by hybridising *Triticum turgidum* L. with *Aegilops tauschii* Coss., the evolutionary progenitors of bread wheat (*Triticum aestivum* L.), have shown potential value for use in Australian bread wheat breeding. This study investigated primary and derived synthetic wheats in three ways to further evaluate this value. To determine whether primary synthetic wheats could broaden genetic diversity in Australian bread wheats, genetic similarity between and among 44 primary synthetics and nine modern Australian bread wheats was investigated using Diversity Array Technology™ (DArT). Greater dissimilarity was observed between these germplasm groups than within these groups. The A and B genomes of the primary synthetics were most divergent from the genomes of the bread wheats. These primary synthetics therefore could broaden the genetic diversity in Australian bread wheats. To identify primary synthetic wheats that could improve grain yield of an Australian bread wheat in drought, grain yield and its major components (grain weight and grains per m^2) were measured in 27 BC_1 synthetic-derived families of lines in five drought stressed environments in southern Australia. Fourteen families included lines with significantly ($p<0.05$) higher grain yield than Yitpi (recurrent bread wheat parent). These lines produced grain yields up to 12.0 % higher than Yitpi in the highest yielding environments, where improved grain weights were responsible. In the lowest yielding environments, superior synthetic derivatives achieved grain yields up to 43.8 % higher than Yitpi, with more grains per m^2 commonly responsible. Therefore, many but not all of the primary synthetics assessed could improve grain yield of an Australian bread wheat in drought. To gain an understanding of synthetic allele introgression into the genetic background of an Australian bread wheat, DArT loci were assayed in two families of synthetic backcross lines. Approximately half of the same loci assayed in each family showed synthetic allele introgression. At regions on chromosome 2A in both families, synthetic alleles were positively associated with grain weight and grain per m^2. It was concluded that primary and derived synthetic wheats can have broad value to bread wheat breeding in Australia.

Declaration

This work contains no material which has been accepted for the award of any other degree or diploma in any university or other tertiary institution and, to the best of my knowledge and belief, contains no material previously published or written by another person, except where due reference has been made in the text.

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Stephen John Talbot
March 2011

Acknowledgements

I would like to thank my supervisors, Professor Diane Mather, Associate Professor Kenneth Chalmers and Dr Francis Ogbonnaya for their academic supervision. I greatly appreciated the teachings from Professor Andrew (Andy) Barr, who was my initial primary supervisor before a change in his work commitments.

I thank the trustees of the South Australian Grains Industry Trust (SAGIT) for providing the funding for my project through the Molecular Plant Breeding Cooperative Research Centre (MPBCRC). MPBCRC provided professional development during my candidature, which was in-part led by Dr Heather Bray, a friend and supporter during my studies.

I am indebted to the staff of Australian Grain Technologies (AGT), in particular Dr Haydn Kuchel, Dr Jason Reinheimer and Simeon Hemer, who provided much guidance, logistical help and expert knowledge during my studies. AGT provide in-kind field support that made my field endeavours possible.

The following people and organisations have been important contributors to my project:

- Paul Eckermann and Dr Bev Gogel (GRDC National Statistics Program) for their advice and support on trial design and analysis,
- Dr Harbans Bariana (Plant Breeding Institute, University of Sydney) for disease nursery and glasshouse screening support,
- Jim Lewis (SARDI) for encouragement and the use of equipment,
- Barley Program (University of Adelaide) for the use of equipment,
- Members of the Molecular Marker Lab (University of Adelaide), in particular Elysia Vassos and Dr Genet Mekuria for their friendship and encouragement.

I would like to thank my parents, Graham and Helen Talbot for encouraging me to always do my best, and my siblings, extended family and friends for their ongoing support.

Professional editorial advice was sought from Mrs Margaret Cargill (Adjunct Senior Lecturer, University of Adelaide) on spelling, grammar, sentence and paragraph structure and language clarity. This advice was restricted to standards D and E of the Australian Standards for Editing Practice (ASEP). Mrs Margaret Cargill‟s current or former area of academic specialisation is not similar to that presented in this thesis.